Aerodynamic Drag Reduction for Heavy Vehicles Using Plasma Actuators

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ABSTRACT

We propose to use dielectric barrier discharge (DBD) plasma actuators for heavy vehicles drag reduction. Recently, the plasma actuators have been successfully used to control low speed boundary layer flows. Such a discharge imparts a body force inside the boundary layer of a fluid in the vicinity of an exposed electrode. The power consumption of this device was reported to be only a few watts per meter length of the actuator. In this paper, numerical tools are employed to investigate the mechanisms of aerodynamic drag reduction for heavy vehicles using plasma actuators. In plasma modeling, a finite element based multiscale ionized gas (MIG) flow code is used for solving body force produced by plasma actuators. For flow modeling, LES (Large Eddy Simulation) turbulence model is used to analyze the drag reduction. The numerical results will be validated against the experimental data for the heavy vehicle with or without plasma actuators installed. Successful completion of this research can revolutionize the state-of-the-art in heavy vehicle design and improve the fuel consumption and emissions of the vehicle.

Keywords: aerodynamic drag reduction, plasma actuator, active flow control, large eddy simulation.

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